



NOAA Technical Memorandum NMFS-SEFSC-666

## **Observer Coverage of the 2014 Gulf of Mexico Skimmer Trawl Fishery**

By

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## Introduction

The skimmer trawl fishery in the northern Gulf of Mexico targets inshore areas to harvest penaeid shrimp (Family Penaeidae). The primary species targeted are brown shrimp, *Farfantepenaeus aztecus*, from May through July, and white shrimp, *Litopenaeus setiferus*, from August through December. Skimmer trawls have been documented in Louisiana, Alabama, and Mississippi as well as North Carolina. In 2013, Louisiana sold 3,236 resident (\$25 per net) and 76 non-resident (\$100 per net) commercial skimmer net licenses.<sup>1</sup> Skimmer trawls are unique in that the nets are attached to rigid frames on the vessel instead of using conventional otter trawl doors to open the net. This allows the vessel operator to retrieve the cod ends while the nets are still actively fishing. Butterfly nets are very similar in concept to skimmer trawls, but a butterfly net has a rigid bottom frame that forms a square completely encircling the net opening.<sup>2</sup> Numerous studies in the past have examined various aspects of the skimmer trawl fishery in the southeastern U.S. providing a background of information (Hines et al., 1993; Coale et al., 1994; Hein and Meier, 1995; Scott-Denton et al., 2007; Price and Gearhart, 2011; Pulver et al., 2012; Pulver et al. 2014).

Sea turtle mortality resulting from commercial shrimping operations in the Gulf of Mexico has been documented in the past by other studies (Magnuson et al., 1990; Epperly et al., 2002). For example, the mandatory observer program for Federal penaeid and rock shrimp (Family Sicyoniidae) permit holders primarily using otter trawls in the Gulf of Mexico and South Atlantic from July 2007 through December 2012 documented 55 sea turtle captures (Scott-Denton et al., 2012). Price and Gearhart (2011) reported three Kemp's ridley sea turtle,

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<sup>1</sup> Louisiana Department of Wildlife and Fisheries. 2014. 2000 Quail Dr., Baton Rouge, Louisiana. (available at <http://www.wlf.louisiana.gov/licenses/statistics>).

<sup>2</sup> North Carolina Sea Grant. Coastwatch Holiday 2004. Shrimp: No Small Catch, Harvests Features Skimmer Otter Trawls. (available at <http://ncseagrant.ncsu.edu/coastwatch>).

*Lepidochelys kempii*, captures during turtle excluder device (TED) evaluations aboard skimmer trawl vessels from North Carolina in 2010; all sea turtles captured were released alive and occurred in skimmer trawl nets not equipped with TEDs.

An increase in sea turtle strandings occurred in 2010 and 2011 in the northern Gulf of Mexico, primarily in the Mississippi Sound area. Necropsies indicated forced submergence to be the most probable cause for a significant number of the stranded sea turtles. Historically, the skimmer trawl fishery has been exempt from the use of a TED in lieu of seasonal tow-time restrictions of less than 55 min from April 1 to October 31 and no more than 75 min for the rest of the year.<sup>3</sup> Interest in the possible causes for the increase in sea turtle strandings prompted mandatory observer coverage for the Gulf of Mexico skimmer trawl fishery, which was implemented in May 2012 by the Southeast Fisheries Science Center (SEFSC) Galveston Observer Programs (Pulver et al., 2012).

Additionally, a rule to require the use of TEDs in place of the seasonal tow time restrictions for the skimmer fishery was proposed by the Southeast Regional Office in May 2012.<sup>4</sup> Data from the 2012 observer coverage of the skimmer trawl fishery were used to examine the potential implications of implementing this rule (Pulver et al., 2012; Epperly and Stokes, 2012). A number of factors were examined when the proposed rule to require TED use was withdrawn in February 2013.<sup>5</sup> Some of these factors included the effectiveness of TEDs for the size of sea turtles encountered; condition of sea turtles when captured; TED enforcement; and possible tow time implications. The majority (58%) of the sea turtles captured during the 2012

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<sup>3</sup> Federal Register. 1992. Final rule establishing limited tow-times as an alternative to turtle excluder devices. 57 FR 57348.

<sup>4</sup> Federal Register. 2012. Proposed rule to withdraw the alternative tow-time restriction and require all skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) rigged for fishing to use turtle excluder devices in their nets. 77 FR 27411.

<sup>5</sup> Federal Register. 2013. NOAA Fisheries decision to withdraw a proposed rule requiring turtle excluder devices in skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) at this time. 78 FR 9024.



observer coverage were small enough to pass through the maximum 4-inch TED bar spacing currently allowed. It was hypothesized that the elimination of tow time restrictions would likely increase tow times, thus potentially increasing mortality for any sea turtle passing through the TED grid into the cod end of the trawl. Even though tow time restrictions were exceeded on 65% of the tows observed in 2012, all sea turtles (24) captured were released alive. One sea turtle was comatose when captured, but active when released. Finally, the majority of skimmer vessels operate in Louisiana state waters where Federal TED requirements are not enforced by state law enforcement due to state legislation.<sup>6</sup> State legislators are currently working to repeal this ban on TED enforcement in Louisiana.<sup>7</sup> Moreover, the SEFSC Harvesting Systems Unit is currently assessing the effectiveness of 3-inch TED bar spacing for skimmer trawls through a voluntary research effort.

The mandatory observer coverage of the fishery begun in 2012 has been continued into 2013 and 2014 to increase the amount of information available on the skimmer trawl fishery, particularly to document sea turtle interactions. The primary objectives were the same as the previous studies: 1) document interactions with threatened or endangered sea turtles during commercial shrimping operations and; 2) quantify both target and nontarget species by area. The specific objectives of this paper are to: 1) summarize trip, vessel, environmental, and gear characteristics; 2) quantify fish and protected species captures; and 3) estimate catch per unit of effort (CPUE) trends and spatial distribution for target and nontarget species, excluding protected species.

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<sup>6</sup> Louisiana Revised Statutes § 56:57.2. Turtle excluder devices; findings; enforcement of federal requirements; rules and regulations.

<sup>7</sup> Turtle Island Restoration Network. 2014. Louisiana Moves to Protect Sea Turtles. (available at <http://www.wallacejnichols.org/101/788/press-release-louisiana-moves-to-protect-turtles.html>).

## **Methods**

Methods used in this investigation were similar to those described for the voluntary coastal Louisiana skimmer trawl observer program in 2004–2005 (Scott-Denton et al., 2007), the current mandatory Federal shrimp observer program operating in the U.S. Gulf of Mexico and along the U.S. southeastern Atlantic coast (Scott-Denton et al., 2012), and the initial mandatory skimmer trawl coverage in 2012 (Pulver et al., 2012). For 2014 coverage, NMFS-approved observers were placed on selected skimmer trawl vessels primarily fishing for brown shrimp off Louisiana, Mississippi and Alabama from May through July 2014.

The authority to place observers on commercial fishing vessels falls under the Endangered Species Act of 1973 as amended. In addition, pursuant to Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA; 16 USC 1801), fishery permit or license holders are required to carry an observer if selected for Federal mandatory coverage. Among the several provisions promulgated under MSFCMA § 303(b)(8) is a mandate for vessel owners to obtain a current United States Coast Guard (USCG) Commercial Fishing Vessel Safety Examination decal prior to the selection period for Federal mandatory observer coverage.

Vessel selection was based on state penaeid shrimp trips obtained from the Gulf Shrimp System (GSS) database. At the time of the selection, very limited 2013 data were available for Louisiana in the GSS database. For this reason, all vessels that had landings using skimmer trawl gear during 2012 (instead of 2013) were selected. This query was subsequently filtered against the USCG license file for a total of 277 permit holders who were notified by certified mail that they were selected to carry an observer during the May through July 2014 period.

Upon receipt of the letter, vessel owners were required to contact program staff within 24-hours to make arrangements to carry an observer.

Although most trips were typically two to four days in duration, a minimum sea day requirement of five days was established to augment logistical considerations and minimize travel costs. For each observed trip, vessel length, hull construction material, gross tonnage, engine horsepower, and crew size information were recorded. Gear characteristics related to bycatch reduction device (BRD), TED, net type and other associated gear were recorded at the start of each trip and updated if changes were made during the trip. Tow time, vessel speed, and operational aspects relative to each net were also documented for each tow.

Skimmer trawl vessels are equipped with two framed nets (port and starboard) during fishing operations. For the entire duration of the trip, both nets were monitored for protected species interactions. For sampling finfish and shrimp, the observer randomly (coin flip) picked a net to start sampling (i.e. port or starboard). The observer continued to sample that net until a break in fishing operations. At that point, the observer sampled the other net. The net being sampled was alternated back and forth until the completion of the trip.

For the net being sampled, tow time in and out was defined as when the cod end (bag) was deployed in the water and when the cod end was brought onboard the vessel (i.e., bag in - bag out). All tow times were recorded to the nearest whole minute. Cod ends may be periodically brought up to the surface without being brought onboard (remaining in the water) to determine the size of the catch and check for protected species interactions. In this study, tow time out was not recorded until the cod ends were brought fully onboard the vessel.

Skimmer trawl operations allow the nets to fish continuously while retrieving only the cod end. For tows when the frames remained in the water between tows, the subsequent tow's

start time was recorded as the next whole minute after the previous tow's end time. This accounted for the time when frames remained in the water while dumping the catch and redeploying the cod end. If both the frames and cod ends were picked up out of the water, the next tow's start time was recorded when the frames and cod ends were redeployed, as both are deployed simultaneously.

On the majority of tows (98%), both cod ends were picked up at the same time. Thus, tow times are known for both nets. However, on some vessels the cod ends were not picked up at the same time. For these vessels, the observer only recorded the time in and out for the net being sampled.

For the net being sampled, the observer attempted to obtain a total weight of the catch and total shrimp weight. Depending on the vessel layout and fishing operations, observers made an effort to characterize a portion or subsample of the catch for species grouping. A detailed description of at-sea collection methods and data requirements are presented in the Galveston Laboratory's observer manual entitled "Characterization of the U.S. Gulf of Mexico and Southeastern Atlantic Otter Trawl and Bottom Reef Fish Fisheries".<sup>8</sup>

## **Data Analysis**

Extrapolation, variance estimates, and CPUE are the same as described by Scott-Denton et al. (2011), Scott-Denton et al. (2012), Pulver et al. (2012) and Pulver (2014). Species total weights were extrapolated from subsample weight using the total catch weight, and were based on all sampled nets per tow. The coefficient of variation (CV) was used as a measure of precision for bycatch estimates as described in "Evaluating Bycatch" (NMFS, 2004). CV estimates were calculated by dividing the estimated standard error by the estimate of the mean

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<sup>8</sup> NMFS. 2014. Characterization of the U.S. Gulf of Mexico and southeastern Atlantic otter trawl and bottom reef fish fisheries. Observer Training Manual. NMFS, Southeast Fisheries Science Center, Galveston Laboratory, Galveston, Texas. (available at [http://www.galvestonlab.sefsc.noaa.gov/research/fishery\\_management/index.html](http://www.galvestonlab.sefsc.noaa.gov/research/fishery_management/index.html)).

CPUE (kg per hour for selected species).

To identify patterns in CPUE for species of interest a local spatial statistic, the Getis-Ord  $G_i^*$  ( $G_i^*$ ), was calculated using the Hot Spot Analysis tool in ArcGIS<sup>9,10</sup> to locate clusters of features with similarly high or low values. A detailed description of the Hot Spot Analysis tool is given in Scott-Denton et al. (2011) and Scott-Denton et al. (2012). The Optimized Hot Spot Analysis tool selects a scale of analysis based on peak distances for spatial autocorrelation. For the skimmer trawl fishery, these distances were 14,054 m for shrimp CPUE and 11,679 m for bycatch. The Optimized Hot Spot Analysis tool also applies a false discovery rate when determining statistical significance to correct for multiple testing and spatial dependence.

Sea Turtle data were reported on a modified SEFSC Sea Turtle Life History Form (Belskis et al. 2009, revised 2011) and sampled following SEFSC protocols (NMFS, 2008). The Sea Turtle Life History forms were transmitted to the SEFSC in Miami where the data were entered into the Sea Turtle Life History database. All fishery data were entered into the southeast regional shrimp trawl bycatch database. This database is housed at the SEFSC Galveston Laboratory and was developed in 1992 through cooperation with commercial fishing interests, state fishery management agencies, and universities.

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<sup>9</sup> Mention of trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

<sup>10</sup> ArcGIS 10.2 Computer Software. 380 New York Street, Redlands, California 92373 (available at <http://www.esri.com/software/arcgis/index.html>).

## Results

### Fishing Characteristics

For the 277 state permit holders selected for observer coverage, 15 carried an observer, 18 contacted the program stating they would carry an observer if they fished but never called back, 60 stated the vessel was sold, inactive, or not using skimmer trawl gear, and 182 permit holders selected did not contact the program. Two permit holders refused to carry observers. From May through July 2014, data from 634 tows were collected during 18 trips (82 sea days) aboard 15 unique skimmer trawl vessels. Trip, vessel, tow and environmental characteristics are summarized (Table 1).<sup>11</sup>

Trip length averaged 4.6 days with an average of 35 tows per trip. Vessel length ranged from 37 to 58 ft, with a mean of 46.3 ft. The majority (60%) of vessels were fiberglass construction. Average tow time for all nets was 1.07 h (64.2 min) with a range of <0.10 to 2.38 hours. Average tow time for all nets not equipped with a TED was similar at 1.06 h (63.8 min). Average fishing depth was 1.9 fm. Most tows (99%) occurred in seas <2 ft in wave height. Based on total hours towed, the highest concentration of effort occurred near Caillou Bay in coastal Louisiana (Figure 1).

Net characteristics for observed skimmer trawl vessels are given for all nets towed (Table 2). Headrope length ranged from 16 to 20.1 ft with an average of 16.7. Several dominant trawl characteristics included trawl body (polyethylene) and cod end material (nylon), extension (none), and lazy line rigging (choke rings). Trawl body mesh size ranged from 1.3 to 2.4 in with a mean of 1.6 in. Approximately 46% of nets (Table 3) were equipped with fisheye BRDs; however, only 5% of nets were equipped with TEDs.

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<sup>11</sup> Percentages may not equal 100% due to rounding.

## Catch Composition

For nets that had an effort value and an associated total catch and shrimp weight recorded, 31,091 kg of total catch were documented from 607 nets (662 h). Penaeid shrimp comprised 10,857 kg (heads-on) or 35% of the total weight. Average retained penaeid shrimp CPUE was 16.4 kg/h.

## Extrapolated Species Composition

Weight extrapolations from species characterization data collected from 82 nets (99.9 h) were placed into major categories (Table 4). In terms of percent composition and CPUE, finfish dominated the catch at 64% (25.1 kg/h), followed by penaeid shrimp at 34% (13.4 kg/h), crustaceans at 2% (0.7 kg/h), debris at 1% (0.3 kg/h), invertebrates at <1% (0.1 kg/h), and discarded penaeid shrimp at <0.1 %. Overall (total catch) CPUE was 39.5 kg/h. A total of 16 taxa (or species groupings) were identified (Table 4). Three species comprised approximately 87% of the total catch: grouped finfish species at 41%, brown shrimp at 26%, and Atlantic croaker, *Micropogonias undulates*, at 20%.

CPUE and variance estimates for selected taxa collected from all sampled nets from May through July 2014 depict very good CV estimates (<0.2) for several species of finfish, penaeid shrimp, other crustaceans and invertebrates (Table 4). CVs were higher for some species of sciaenids (Family Sciaenidae) and mackerels (Family Scombridae) with some equal to 1.0. Based on weight extrapolations from species composition samples, the bycatch to penaeid shrimp ratio was 1.94. The finfish to penaeid shrimp ratio was 1.87.

A statistically significant clustering of high CPUE for penaeid shrimp was most pronounced in Barataria Bay (Figure 2). A clustering of high CPUE for bycatch, excluding protected species, was detected in areas near Vermilion Bay (Figure 3).

## Protected Species

Locations for the ten sea turtles captured on observed trips using skimmer trawl gear are given (Figure 4). Sea turtle captures occurred consistently in areas with the highest effort measured by tow hours (Figure 1). Four captures were identified as Kemp's ridley sea turtle species, three green sea turtles, *Chelonia mydas*, and three loggerheads, *Caretta caretta*. Six sea turtles were released alive; three were released fresh dead, and one was previously dead when captured. Details for observed sea turtles captured are given (Table 5).

Figures 5 and 6 depict observed tow times in minutes, and the seasonal legal maximum tow time (55 minutes) for all tows combined and for nets without a TED observed respectively. Based on observer data, 27.8% of all tows and 28.6% of all tows from nets without TEDs were below the seasonal 55-minute limit based on calculated tow times.

## Discussion

Fishing characteristics, observer coverage levels, and catch rates have varied over the past three years (2012–2014) of coverage (Table 6). Vessel compliance was lower (18 trips) in 2014 as compared with previous years. And as such, may not be representative of the fishery as a whole in terms of fishing practices, vessel characteristics, and geographic distribution/coverage.

Average trip length ranged from a low of 2.1 days in 2012 to 4.6 days in 2014. The number of tows per trip increased to 35 tows in 2014 compared with 14 tows in 2012. Tow times ranged from a low of 0.95 h in 2012 to 1.07 h in 2014, with the highest compliance rate with the 55-min tow time restriction (38%) in 2013.

Observer coverage substantially decreased, based on the metric of sea days, in 2014 compared with the previous two years. While the number of sea days was lower, total hours



towed (662 h) in 2014 was only slightly lower to hours towed (695 h) in 2012, with more total catch (31,091 kg) documented in 2014 as compared with total catch (26,965 kg) in 2012. Moreover, the bycatch to penaeid shrimp ratio (1.94) increased by a factor of two in 2014 as compared to the ratio (0.92) in 2013, indicative of bycatch comprising a larger percentage of the catch. Shrimp CPUE (16.4 kg/hr) was lower in 2014 than compared with CPUE (20.3 kg/hr) in 2013, but slightly higher than CPUE (14.3 kg/hr) documented in 2012. These differences in CPUE were reflected in Louisiana brown shrimp landings data in 2012 and 2013 with 18 million pounds (tails) landed and in 2012 and 25 million pounds in 2013.<sup>12</sup>

The number of sea turtle captures has fluctuated each year of coverage with a high of 24 observed in 2012 to a low of 8 observed in 2013. Sea turtle interactions were slightly higher (10) in 2014. While the fewest number of Kemp's ridley interactions were observed in 2014, loggerhead interactions were observed for the first time and the number of green turtle interactions also increased compared with other years. Also of note, two of the three sea turtle that died were green turtles. These annual fluctuations in the number, species composition, or fate of sea turtle interactions could be attributed to weather, water temperature, animal abundance, difference in spatial coverage, or other unknowns.

Since the early 1990's, TEDs have been used in the penaeid shrimp fishery otter trawl fishery to reduce sea turtle bycatch. Gallaway et al. (2008) suggested a shrimp loss rate of 6% associated with TED use in offshore waters of the southeastern U.S. Price and Gearhart (2011) had a combined mean shrimp loss rate of 5% from inshore skimmer trawl "Super Shooter" style TED during testing in North Carolina in 2010. Many solutions have been proposed to address the potential for sea turtle mortality in the skimmer trawl fishery. One gear solution being

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<sup>12</sup> NMFS. 2014. Gulf Shrimp System, SEFSC Galveston Laboratory.

examined is lowering the maximum TED bar spacing allowed from 4 in to 3 in to reduce the potential of small sea turtles passing through the TED bar grid. The SEFSC Harvesting Systems Unit is currently studying the catch loss and feasibility of using these TEDs in the inshore skimmer trawl fishery in Louisiana and North Carolina through research conducted by voluntary skimmer vessels. Additional efforts include improving industry outreach and addressing tow time compliance issues in the fishery. For future consideration, continued research would provide more accurate estimates of protected species interactions in the skimmer trawl fishery. Observer programs remain a vital component in addressing concerns associated with commercial fishing operations.

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### **Literature Cited**

- Belskis, L. C., Epperly, S. P., and Stokes, L.W. 2009, Revised January 2011. Southeast Fisheries Science Center sea turtle observer manual. NOAA Technical Memorandum NMFS-SEFSC-589, 30 p.
- Coale, J. S., R. A. Rulifson, J. D. Murray, and R. Hines. 1994. Comparisons of shrimp catch and bycatch between a skimmer trawl and an otter trawl in the North Carolina inshore shrimp fishery. *North American Journal of Fisheries Management* 14: 751-768.
- Epperly, S., L. Avens, L. Garrison, T. Henwood, W. Hoggard, J. Mitchell, J. Nance, J. Poffenberger, C. Sasso, E. Scott-Denton, and C. Yeung. 2002. Analysis of sea turtle bycatch in the commercial shrimp fisheries of southeast U.S. waters and the Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-490, 88 p.
- Epperly, S. P., and L. W. Stokes. 2012. Observed sea turtle takes in the skimmer trawl fishery. NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL. SEFSC Contribution PRBD-2012-05.
- Gallaway, B. J., J. G. Cole, J. M. Nance, R. A. Hart, G. L. Graham. 2008. Shrimp loss associated with turtle excluder devices: Are the historical estimates statistically biased? *Northern American Journal of Fisheries Management* 28(1): 203-211.
- Hein, S., and P. Meier. 1995. Skimmers: Their development and use in coastal Louisiana. *Marine Fisheries Review* 57(1): 17-24.
- Hines, R., S. Coale, R. Rulifson, and J. Murray. 1993. The skimmer trawl in North Carolina estuaries. University of North Carolina Sea Grant College Program, Report UNC-SG-93-01, 24 p.

Magnuson, J. J., K. A. Bjorndal, W. D. DuPaul, G. L. Graham, D. W. Owens, C. H. Peterson, P. C. H. Pritchard, J. I. Richardson, G. E. Saul, and C. W. West. 1990. Decline of the sea turtles: causes and prevention. National Academy Press, Washington, D.C., 259 p.

NMFS. 2004. Evaluating bycatch: a national approach to standardized bycatch monitoring program. NOAA Technical Memorandum NMFS-F/PO-66, 108 p.

NMFS. 2008. Sea turtle research techniques manual. NOAA Technical Memorandum NMFS-SEFSC-579, 92 p. [updated 1/2009].

Price, A. B. and J. L. Gearhart. 2011. Evaluations of turtle excluder device (TED) performance in the U.S. southeast Atlantic and Gulf of Mexico skimmer trawl fisheries. NOAA Technical Memorandum NMFS-SEFSC-615, 15 p.

Pulver, J. R., E. Scott-Denton, and J. A. Williams. 2012. Characterization of the U.S. Gulf of Mexico skimmer trawl fishery based on observer coverage. NOAA Technical Memorandum NMFS-SEFSC-636, 27 p.

Pulver, J.R., E. Scott-Denton and J.A. Williams. 2014. Observer coverage of the 2013 Gulf of Mexico skimmer trawl fishery. NOAA Technical Memorandum NMFS-SEFSC-654, 25 p.

Scott-Denton, E., P. Cryer, J. Gocke, M. Harrelson, K. Jones, J. Pulver, J. Nance, R. Smith, and J.A. Williams. 2007. Skimmer trawl fishery catch evaluations in coastal Louisiana, 2004 and 2005. Marine Fisheries Review 68(1-4): 30-35.

Scott-Denton, E., P. F. Cryer, J. P. Gocke, M. R. Harrelson, D. L. Kinsella, J. R. Pulver, R. C. Smith, and J. A. Williams. 2011. Descriptions of the U.S. Gulf of Mexico reef fish bottom longline and vertical line fisheries based on observer data. Marine Fisheries Review 73(2): 1-26.

Scott-Denton, E., P. Cryer, M. Duffy, J. Gocke, M. Harrelson, D. Kinsella, J. Nance, J. Pulver, R. Smith, and J. Williams. 2012. Characterization of the U.S. Gulf of Mexico and South Atlantic penaeid and rock shrimp fisheries based on observer data. *Marine Fisheries Review* 74(4): 1-27.

Table 1. —Trip, vessel, set, gear, and environmental characteristics observed in the U.S. Gulf of Mexico skimmer trawl fishery from May through July 2014.

Trip	Vessel	Tows	Environmental
82 Sea days 18 trips aboard 15 vessels 634 tows	Length: Avg: 46.3 ft ( $\pm 7.4$ s.d.). Range: 37–58 ft	Tow time: Avg: 1.07 hrs ( $\pm 0.35$ s.d.) Range: <0.10–2.38 hrs	Water depth: Avg: 1.9 fathoms ( $\pm 2.3$ s.d.) Range: 0.5–17.5
Tows per trip: Avg: 35 ( $\pm 20.6$ s.d.) Range: 5–75	Age: Avg: 28 yrs Range: 12–42 yrs		
Trip length (days): Avg: 4.6 ( $\pm 1.8$ s.d.) Range: 1.0–7.0	Hull construction: Fiberglass: 60.0% Fiberglass/wood: 20.0% Steel: 13.3% Wood: 6.7%	Vessel speed: Avg: 2.2 knots ( $\pm 0.6$ s.d.) Range: <0.5–5.3 knots	Sea state: 0 to 2 foot seas: 99.4% 3 to 5 foot seas: 0.6%
Trips per vessel: Avg: 1.2 ( $\pm 0.4$ s.d.) Range: 1–2	Type: Ice boat: 93.3% Freezer: 6.7%		
Crew size: 1–2 individuals (excluding captain)	Engine horsepower: Avg: 399 hp ( $\pm 200$ s.d.) Range: 165–900 hp		

Table 2.—Net characteristics based on mandatory observer coverage of the U.S. Gulf of Mexico skimmer trawl fishery from May through July 2014.

Item		n = 1,268 nets
Main net headrope length (ft)		
Mean		16.7
Range		16.0–20.1
s.d.		1.5
Main net footrope length (ft)		
Mean		27.7
Range		16.0–36.7
s.d.		4.7
Trawl body (%)	Poly	54.1
	Nylon	25.7
	Spectra	13.7
	Other	4.9
	Sapphire	1.6
Trawl body mesh size (in)		
Mean		1.6
Range		1.3–2.4
s.d.		0.3
Cod end (%)	Nylon	68.8
	Poly	31.2
Cod end mesh size (in)		
Mean		1.4
Range		1.3–1.8
s.d.		0.2
Trawl extension type (%)	None	62.1
	Poly	30.4
	Nylon	7.4
Lazy line rigging (%)	Choke	52.2
	Elephant ears	47.8
Tickler chain length (ft)		
Mean		29.1
Range		15.0–35.2
s.d.		3.5

Table 3.—Bycatch reduction device (BRD) and turtle excluder device (TED) characteristics based on mandatory observer coverage of the U.S. Gulf of Mexico skimmer trawl fishery from May through July 2014.

Item		
BRD type (%)	None	54.3
	Fisheye	45.7
BRD fisheye position (%)	None	53.2
	Top	43.5
	Offset	3.2
BRD escape shape (%)	None	54.3
	Half moon	30.2
	Oval	8.1
	Cat eye	7.4
TED type (%)	None	94.8
	Hard	5.2



Table 4.—Targeted species documented from bycatch characterization samples, based on mandatory observer coverage of U.S. Gulf of Mexico skimmer trawl fishery from May through July 2014.

Common name	Scientific name	Extrapolated		Percent total	CV
		weight (kg)	Kg/h		
Fish (superclass)	Pisces	1,616.9	16.2	41.0	0.1
Brown shrimp	<i>Farfantepenaeus aztecus</i>	1,019.2	10.2	25.8	0.1
Atlantic croaker	<i>Micropogonias undulatus</i>	794.4	8.0	20.1	0.1
White shrimp	<i>Litopenaeus setiferus</i>	321.1	3.2	8.1	0.2
Crustacean	Crustacean	64.9	0.7	1.6	0.2
Seatrout (genus)	<i>Cynoscion</i> spp	57.2	0.6	1.5	0.2
Debris (rocks, logs, etc.)	Debris	26.6	0.3	0.7	0.3
Southern flounder	<i>Paralichthys lethostigma</i>	22.3	0.2	0.6	0.2
Spanish mackerel	<i>Scomberomorus maculatus</i>	10.7	0.1	0.3	0.2
Invertebrate	Invertebrate	7.2	0.1	0.2	0.3
Spotted seatrout	<i>Cynoscion nebulosus</i>	5.4	0.1	0.1	0.6
Red drum	<i>Sciaenops ocellatus</i>	0.5	0.0	0.0	1.0
Penaeid shrimp discard (brown,white, pink)	<i>Penaeus</i> discard	0.5	0.0	0.0	0.4
King mackerel	<i>Scomberomorus cavalla</i>	0.3	0.0	0.0	1.0
		3,947.2		100.0	
Non-target species documented and reflected above in Pisces:					
Sheepshead	<i>Archosargus probatocephalus</i>	3.0	0.030		
Common crevalle jack	<i>Caranx hippos</i>	0.2	0.002		

Table 5. —Protected species interactions for all tows based on mandatory observer coverage of the U.S. Gulf of Mexico skimmer trawl fishery from May through July 2014.

Capture date	Species	Capture condition	Release condition	Attempt resuscitate	Water depth (ft)	Tow time (min)	Capture Time (CDT)	CCL (cm)	CCW (cm)	SCL (cm)	SCW (cm)
5/16/2014	Loggerhead	Alive	Released alive	No	10	54	9:01 AM	82.6	81.3	74.6	60.5
5/28/2014	Loggerhead	Alive	Released alive	No	76	66	12:23 PM	69.9	69.6	68.2	56.1
5/29/2014	Green	Fresh dead/ comatose/unresponsive	Discarded marked dead/unresponsive carcass	Yes	6	60	8:59 PM	23.2	19.1	21	
6/2/2014	Kemp's ridley	Alive	Released alive	No	14	30	9:00 PM	28.5	29	26.5	27
6/2/2014	Green	Alive	Released alive	No	4.5	36	11:40 AM	26.7	21	25.4	18.5
6/4/2014	Kemp's ridley	Alive	Released alive	No	5.5	66	11:56 AM	29	29.6	27.3	25.6
7/6/2014	Green	Fresh dead/ comatose/unresponsive	Discarded marked dead/unresponsive carcass	Yes	13.9	78	5:23 PM	31.4	26.2	29.7	23.6
7/10/2014	Loggerhead	Alive	Released alive	No	9	78	8:29 PM	86.2	81	80.6	65
7/10/2014	Kemp's ridley	Fresh dead/ comatose/unresponsive	Discarded marked dead/unresponsive carcass	Yes	8	90	9:57 PM	47.6	48.5	44.6	43.1
7/10/2014	Kemp's ridley	Previously dead	Discarded marked dead/unresponsive carcass	No	5.8	78	10:15 PM	31	28	28	24

Table 6. — Fishing characteristics, observer coverage levels and catch rates from 2012 through 2014 observer coverage of the U.S. Gulf of Mexico skimmer trawl fishery.

Year	2012	2013	2014
Trips	58	35	18
Sea days	119	145	82
Tows	796	1,075	634
Tows per trip	14	31	35
Trip length (days)	2.1	4.1	4.6
Unique vessels	26	26	15
Vessel length (ft)	37.0	49.2	43.3
Tow time (hrs)	0.95	1.05	1.07
Percent w/in 55 min	35	38	28
Water depth (fm)	1.6	2.1	1.9
Headrope length (ft)	17.9	16.9	16.7
BRD use (%)	43	51	46
TED use (%)	5	3	5
Effort (hrs) for nets with recorded effort and total catch and shrimp weight	695	1,025	662
Total catch	26,966	45,683	31,091
Percent shrimp	37	45	35
Shrimp CPUE (kg/hr)	14.3	20.3	16.4
Bycatch:shrimp ratio	1.24	0.92	1.94
Selection period	Apr–Jul	Jan–Jul	May–Jul
Selected	376	375	277
Carried (%)	7	7	5
Called - did not take (%)	13	13	6
Sold/inactive (%)	29	32	22
No contact (%)	49	48	66
Refused (%)	1		1
Number of sea turtles	24	8	10
Kemp's ridley	23	7	4
Loggerhead			3
Green		1	3
Unidentified hardshell	1		
Release alive	24	7	6
Released fresh dead			3
Previously dead		1	1

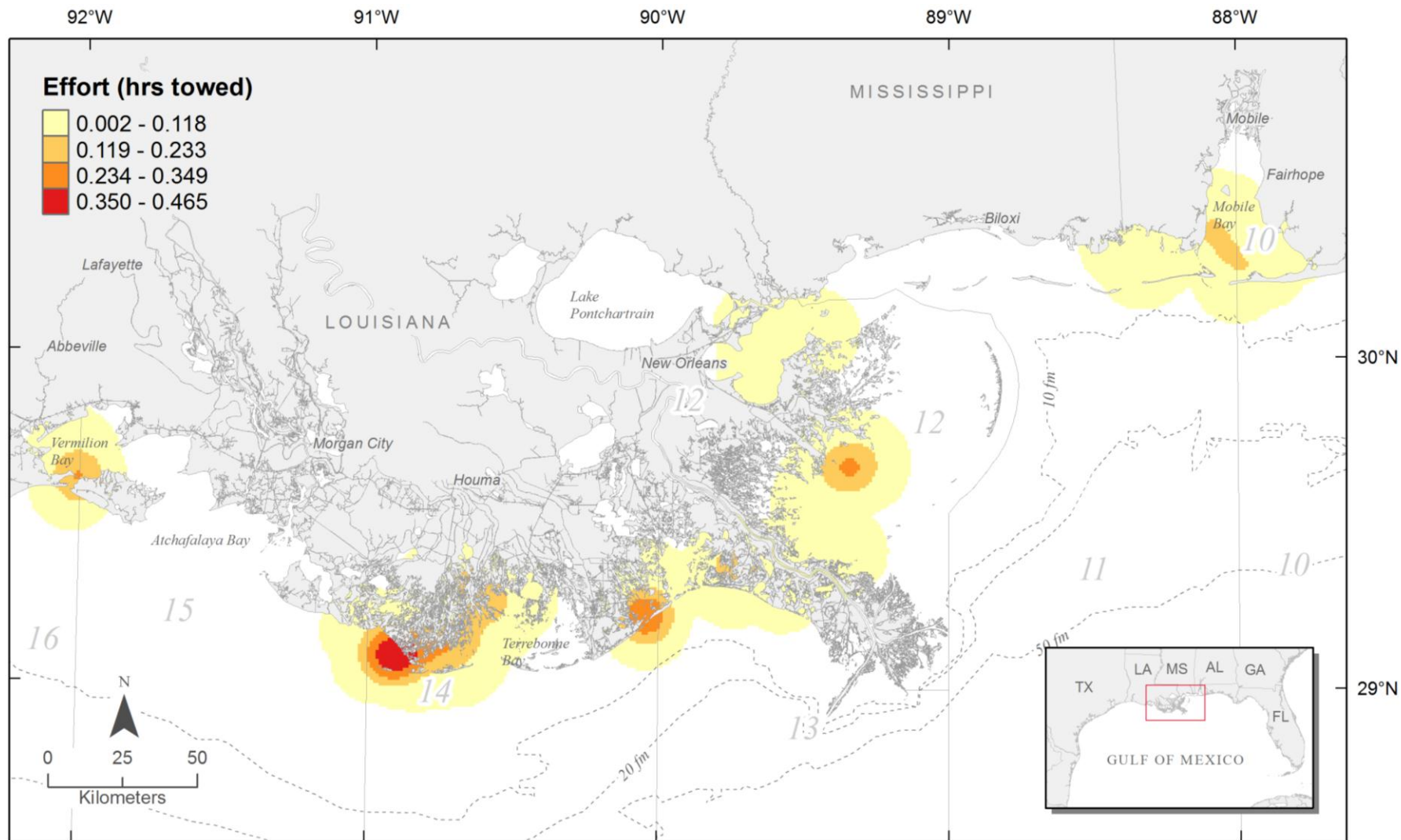


Figure 1.—Skimmer trawl effort by hours based on mandatory observer coverage of the U.S. Gulf of Mexico skimmer trawl fishery from May through July 2014.

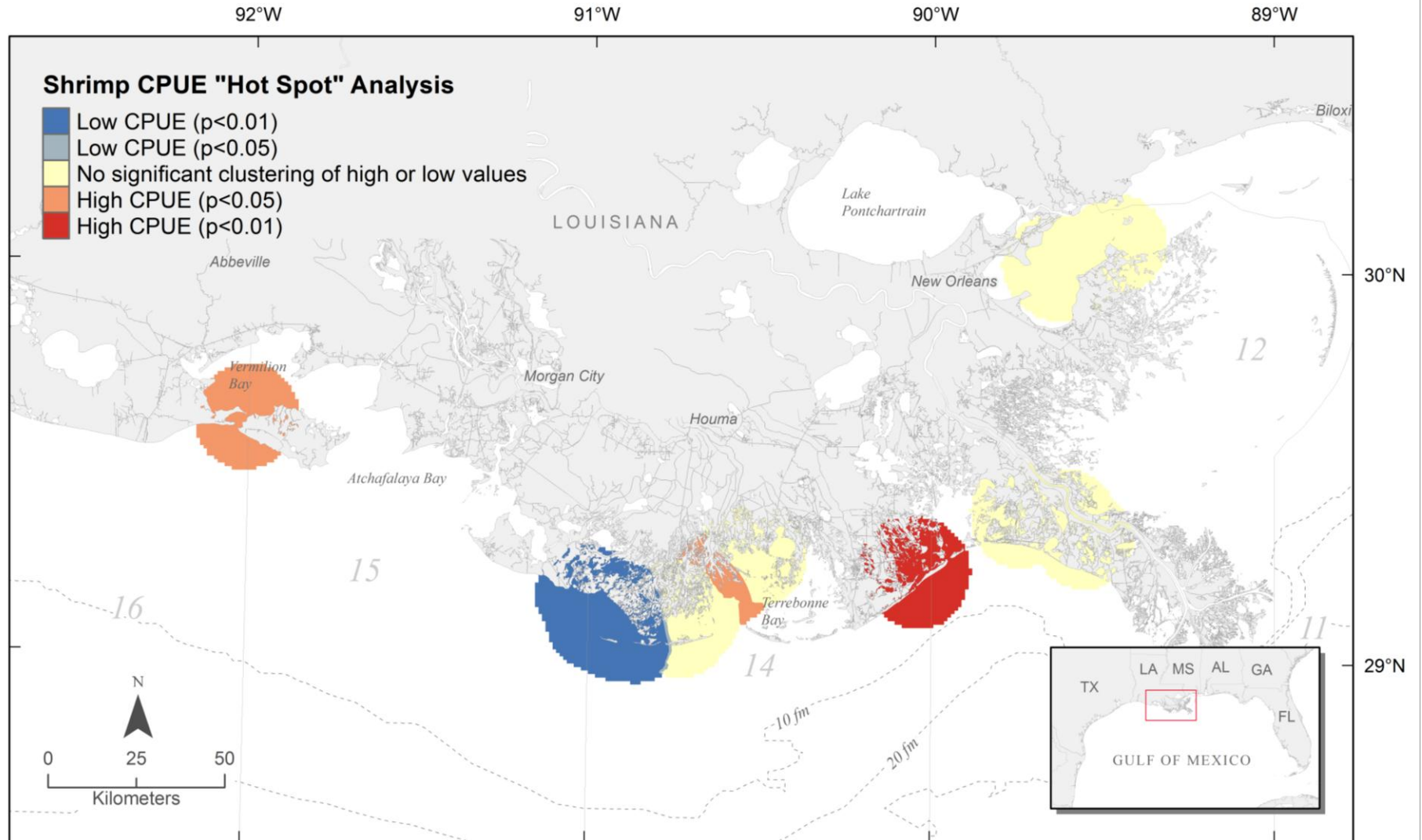


Figure 2. —Shrimp CPUE “Hot Spot” analysis based on mandatory observer coverage of the U.S. Gulf of Mexico skimmer trawl fishery from May through July 2014.

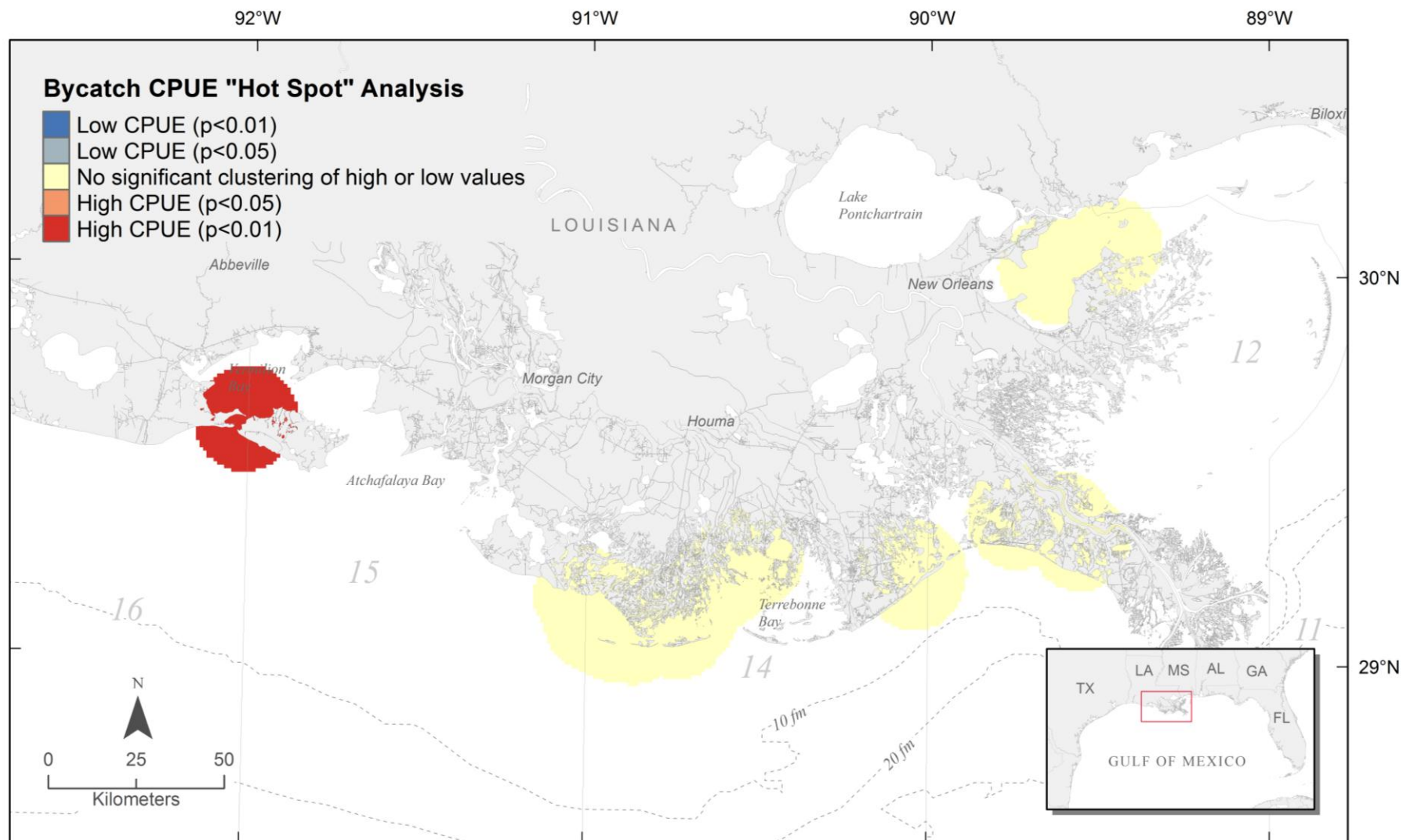


Figure 3. —Bycatch CPUE, excluding protected species, “Hot Spot” analysis based on mandatory observer coverage of the U.S. Gulf of Mexico skimmer trawl fishery from May through July 2014.

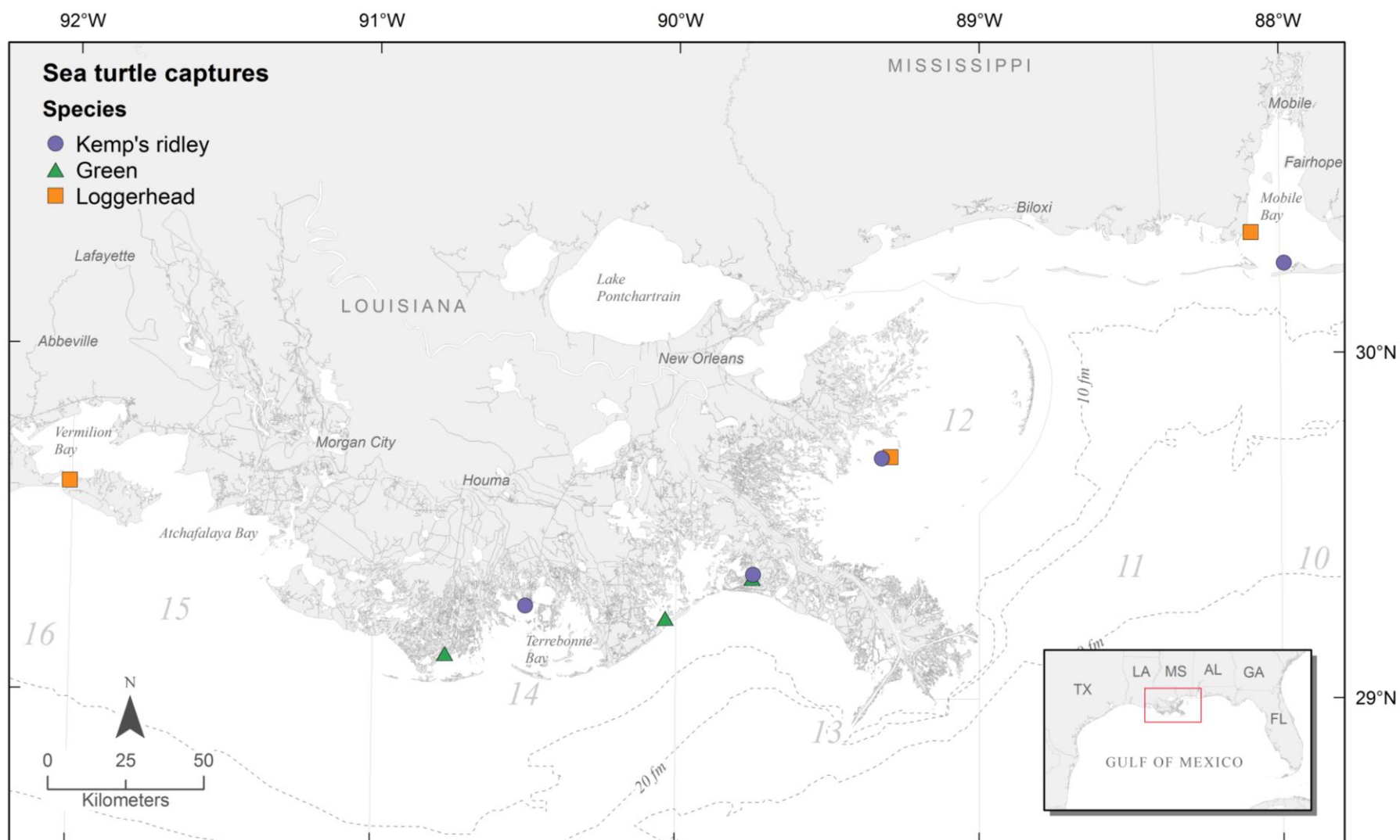


Figure 4. —Sea turtle capture locations based on mandatory observer coverage of the U.S. Gulf of Mexico skimmer trawl fishery from May through July 2014.



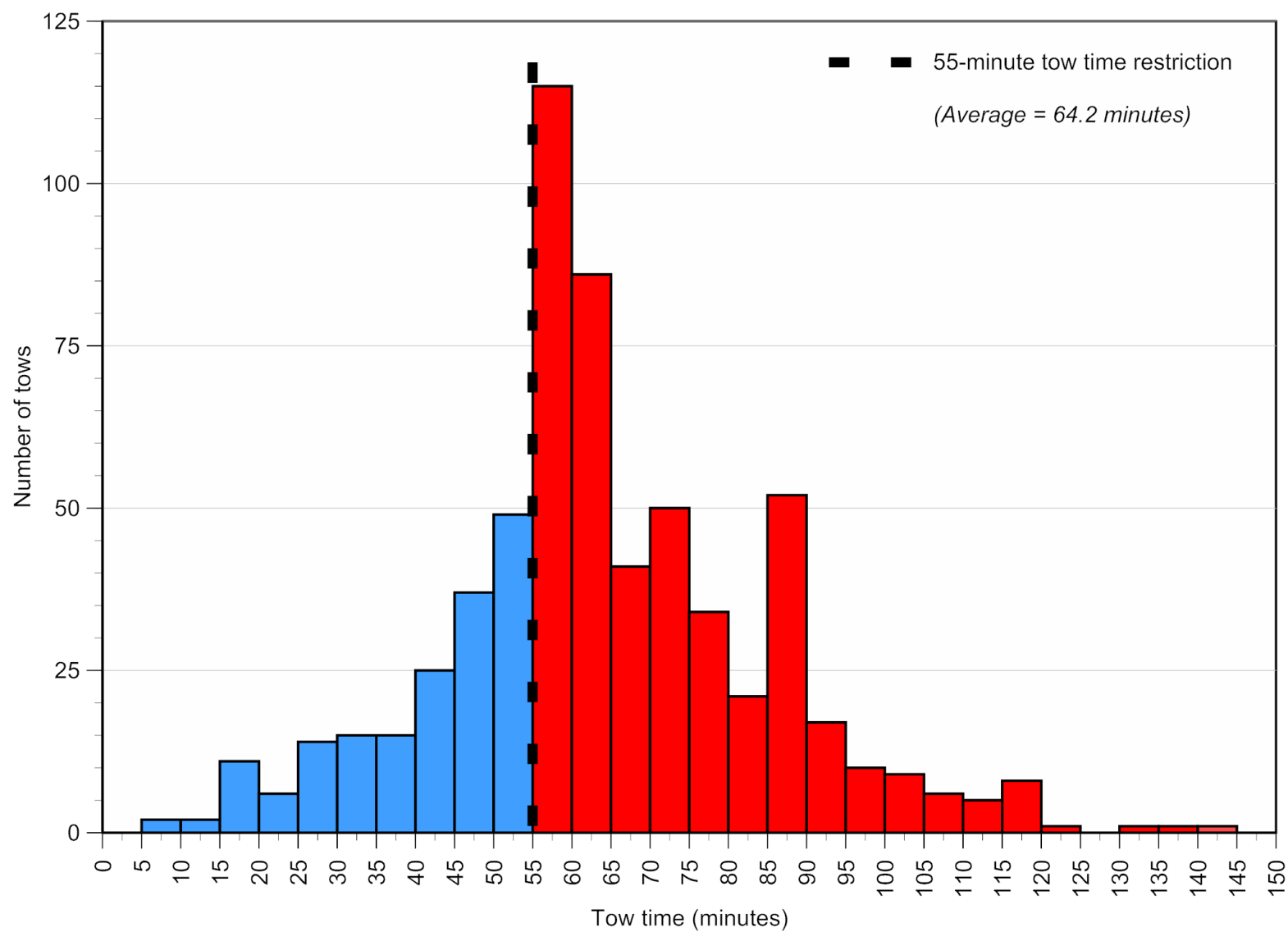


Figure 5. —Skimmer tow times relative to seasonal tow time restrictions for all tows combined based on mandatory observer coverage of the U.S. Gulf of Mexico skimmer trawl fishery from May through July 2014.



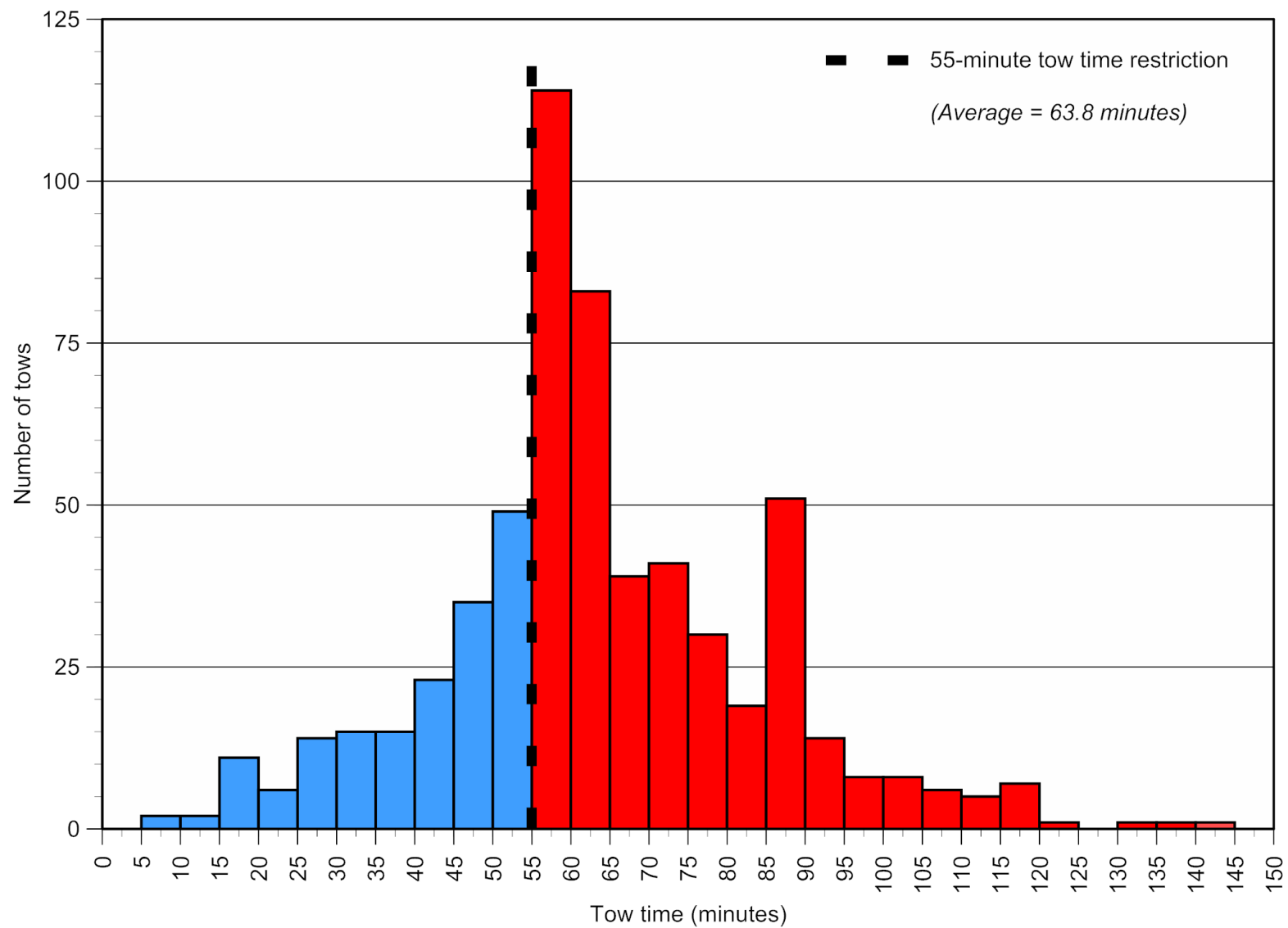


Figure 6. —Skimmer tow times relative to seasonal tow time restrictions for all tows with nets without a TED observed based on mandatory observer coverage of the U.S. Gulf of Mexico skimmer trawl fishery from May through July 2014.

